

Remarks

The Office Action dated February 20, 2004 has been carefully considered. Claims 1, 4, and 11 have been amended. Claims 1-11 are pending in this application.

Support for amendments in claim 1 and 4 may be found throughout the specification and in particular at page 2, lines 22-23, page 4, lines 27, and page 5, lines 24-29 of the specification.

Claim 11 was rejected under 35 USC § 112 second paragraph. Claim 11 has been amended to obviate the rejection. Support for amendment in claim 11 may be throughout the specification and in particular on page 9, lines 10-16, and on page 17, lines 21-29.

Claims 1-11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,256,783 to Takada et al., in view of U.S. Patent No. 4,436,146 to Smolarek and US 4,142,581 to Yoshitomi et al.

The invention defined by the present claim 1 includes the following features. A reactor for catalytic gas phase oxidation which substantially represses migration of a heat medium between a plurality of chambers partitioned with shields and a reaction or treatment is performed at a different temperature, as described in the specification on page 4, lines 1-4, page 5, lines 9-17, page 2, lines 16-23, and page 7, lines 26-27. The shell-and-tube heat exchanger type reactor is partitioned into, for example, two chambers in a substantially closed state, as described in the specification on page 4, lines 25-27. The expansion joint is capable of absorbing the distortion generated by the increase or decrease of the heat of a heat medium, as described in the specification on page 5, lines 24-26.

Takada et al discloses a shell-and-tube type reactor. In contrast to the invention defined by the present claims Takada et al do not disclose or suggest a substantially shielded structure between the tubes and the intermediate tube sheet partitioning a plurality of chambers and an

expansion joint formed around the periphery of each of the chambers, as defined by the present claims.

Rather Takada et al disclose that a shield plate is used between the outer surface of the reaction tubes and the inner surface of the apertures in the shield plate and kept at a distance between 0.2-5 mm. (See Figs. 3-5). In Takada et al, annular fins 34 secured to the reaction tube are used only to prevent the heat transfer medium from moving by keeping the distance between the outer surface of the reaction tube 33 and the inner surface of the apertures 31 in the shield plate 30 to between 0.2-5 mm. Accordingly Takada et al., teach only that each of the tubes passing through the perforated shield plate is not in direct contact with the shield plate.

Further, Takada et al., do not disclose or at least suggest a groove formed in the reaction tube fixing part of the tubes to the intermediate tube sheet, or a structure in which the tube is expanded to at least one groove. There is no teaching in Takada et al regarding such a structure. Moreover, Takada et al., do not disclose any apparatus that achieves the present invention's purpose, which substantially represses migration of the heat media between those chambers partitioned with shields, and substantially closed state chambers. In addition, Takada et al., do not teach or suggest the expansion joint disclosed in the present claims.

Further still Takada et al. teaches away from the present invention . At column 5, lines 27-34 it teaches "The presence of the distance is important and, if the reaction tube 33 and the shield 30 are too closely spaced or secured to each other, the reaction tube and the shield plate are undesirably contacted and abraded where temperature difference between the zones A and B is great or frequent heating or cooling takes place in the reactor". Thus, Takada et al., suggests the problem about the shielded chambers and but does not provide any teaching as to how to overcome the problem accept to prevent the reaction tube and shield plate from being closely spaced or secured to each other.

Comparative Example 1 of the present specification corresponds to the reactor which had reaction tubes not expanded to be tightly fitted to an intermediate tube sheet. Comparing Example 1 of the present invention with Comparative Example 1, the advantageous effects of the invention are showed in the conversion of propylene and the yield of acrylic acid. In addition, Example 2 also indicates of the present advantageous effects as compared to Comparative Example 2-with respect to the- amounts of leakages that were measured. Accordingly, the invention defined by the present claims is not obvious in view of Takeda et al.

Yoshitomi et al describe an ordinary connection manner between a tube and a sheet using grooves so as to improve water tightness by means of expanding the tubes. (See Fig. 3). However, Yoshitomi et al., describe the mere general structure of an expanded tube to tube-sheet joint, but they do not describe or suggest that a tube hole structure can be applied to a shell-and-tube reactor for controlling the different reaction temperatures in the upper and lower chambers. Instead, Yoshitomi et al., teach a better connection manner between the tube and the tube sheet used in heat exchangers and boilers. Moreover, Yoshitomi et al., only describe a method of manufacturing a tube-hole structure for an expanded tube-to-sheet joint used in heat exchangers and boilers. One skilled in the art would not readily apply such a connection between a tube and a tube sheet of the sheet-and-tube type reactor. Takada et al., disclose a reactor having the spaces apart between the tubes and the shield plate by a distance. Even though there is no motivation to combine, if Yoshitomi et al., and Takada et al., are combined, the combination still does not teach a reactor in a closed state, as such is not disclosed in Takada et al or Yoshitomi et al.

Smolarek teaches a shell and tube heat exchanger. A shell is provided with an expansion joint to reduce the tensile or compressive loading between the tube sheets and the tubes as well as between the tube sheets and the shell. However, the expansion joint is within the shell structure of heat exchangers and condenser chambers. In contrast to the invention defined by the present claims, Smolarek does not teach or suggest that the expansion joint is capable of absorbing distortion generated by an increase or decrease in the heat medium.

Further even if the teachings of Smolarek are applied to the teachings of Takada et al., it teaches only the structure in which the expansion is formed around the periphery of the chamber. As described, above Takada et al., only teach a reactor having the spaces apart between the tubes and the shield plate by a distance of 0.2-5 mm.

The Examiner states that the teachings of Takada et al., are easily combined with those of Yoshitomi et al. Applicants submit that the combination would not be made by one skilled in the art, since there is no suggestion therein that the reactor with the connection structure by Yoshitomi et al., prevents the heat medium from migrating from upper to lower chamber or different chambers which is partitioned with shields into a plurality of chambers, or that this can be applied to reactors. Furthermore, there is no motivation to combine Yoshitomi et al with Takada et al because Yoshitomi et al., do not suggest applying their teachings to the reactor, Therefore the teaching of Yoshitomi would not readily be applied to the reactor of Takada et al. Yoshitomi et al., do not suggest applying their teachings to the reactor in a closed state. Takada et al., disclose a reactor which has the spaces apart between the tubes and the shield plate by a distance of 0.2-5mm. Even if Takada et al., is combined with the other cited references, present reactor in the closed state would not be obvious to one skilled in the art.

In view of the foregoing, Applicants submit that all pending claims are in condition for allowance and request that all claims be allowed. The Examiner is invited to contact the undersigned should he believe that this would expedite prosecution of this application. The Commissioner is authorized to charge any deficiency or credit any overpayment to Deposit Account No. 13-2165.

Respectfully submitted,

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